

IN THE CLAIMS

Please cancel claims 1-81, all of the claims, as filed, as set forth in the verified translation of PCT/EP2004/050378. Please also cancel claims 1-78 as filed under Article 34 on December 15, 2004. Please add new claims 82-163 as follows.

Claims 1-81 (Cancelled)

82. (New) A method for the qualitative evaluation of a material having at least one identifying characteristic including:

providing an electronic image sensor;

recording a color image of said identifying characteristic of said material using said electronic image sensor;

obtaining at least one first electrical signal from said electronic image sensor, said at least one first electronic signal being correlated with said color image;

providing an evaluating device connected with said electronic image sensor;

using said evaluating device for evaluating said at least first electronic signal;

providing at least one reference image of the material having at least one identifying characteristic;

obtaining a second electrical signal from said at least one reference image;

storing said at least one reference signal in a data memory;

providing reference variables in said second electronic signal for at least two different properties of a reference image of said first electrical signal;

comparing said first electrical signal with at least said two reference variables contained in said second electrical signal;

checking at least said color image of said identifying characteristic for a deviation from said reference image; and

checking said identifying characteristic regarding its association with one of a defined class of identifying characteristics and a defined geometrical contour and a relative arrangement with respect to at least one further identifying characteristic of said material.

83. (New) The method of claim 82 further including accomplishing said qualitative evaluation of said material during operation of a running work process of a machine processing said material.

84. (New) The method of claim 81 further including conducting at least two qualitative evaluations of said material independently of each other in concurrent checking processes.

85. (New) The method of claim 81 further including storing said color image from said reference image in said data memory of said evaluating device during a learning mode of said evaluating device and using said stored reference image in said evaluating device after changing said evaluating device from said learning mode into a

working mode.

86. (New) The method of claim 84 further including conducting said checks during operation of a running work process of a machine processing said material.

87. (New) The method of claim 85 further including conducting at least two checks independently of each other in parallel extending check processes.

88. (New) The method of claim 83 further including storing said color image from said reference image in said data memory of said evaluating device during a learning mode of said evaluating device and using said stored reference image in said evaluating device after changing said evaluating device from said learning mode into a working mode.

89. (New) The method of claim 85 further including storing at least a single reference image in said evaluation device during said learning mode.

90. (New) The method of claim 83 further including imprinting said material during said running work process.

91. (New) The method of claim 82 further including evaluating said material for controlling its quality.

92. (New) The method of claim 82 further including said material as one of a bill and a stamp.

93. (New) The method of claim 82 further including providing said material in a printed sheet and moving said printed sheet past said image sensor at a speed of up to 18,000 printed sheets per hour.

94. (New) The method of claim 82 further including providing said material as a web of material and moving said web of material past said image sensor at a range of up to 15m/s.

95. (New) The method of claim 82 further including varying a position of said at least one identifying characteristic within an expected range defined by tolerance limits.

96. (New) The method of claim 82 further including providing said image sensor having a plurality of light-sensitive pixels.

97. (New) The method of claim 96 further including providing said at least one first electrical signal from each of said plurality of pixels.

98. (New) The method of claim 82 further including dividing said at least one first electrical signal into a plurality of signal channel.

99. (New) The method of claim 98 further including providing said at least first electrical signal as an RGB signal and making available a portion of said RGB signal in each of said signal channels corresponding to one of the three basic colors red, green and blue.

100. (New) The method of claim 98 further including providing a spectral sensitivity of each of said plurality of signal channels set to a defined spectral sensitivity of a human eye.

101. (New) The method of claim 82 further including matching said first electrical signal in hue, fullness and brightness to a color perception of a human eye.

102. (New) The method of claim 98 further including linking a first of said signal channels with a second of said signal channels by using a first calculation prescription and generating an output signal of a first compensation color channel, and linking a third of said signal channels with a portion of said first and second channels using a second calculation prescription and generating an output of a second compensation color channel, and comparing said outputs of said first and second confirmation color channels with reference variables.

103. (New) The method of claim 102 further including storing said outputs of said first and second compensation color channels in said data memory.

104. (New) The method of claim 103 further including providing said first calculation prescription for providing a weighted difference formation of a portion of said first electrical signal made available in said second signal channel from the corresponding portion in said first signal channel and further providing said second calculation prescription for providing a weighted difference formation of a weighted sum of portions of said first and second signal channels from a corresponding portion in said third signal channel.

105. (New) The method of claim 102 further including subjecting at least one portion of said first electrical signal in said plurality of signal channels to a transformation by using a calculation prescription.

106. (New) The method of claim 102 further including providing said transformation as a non-linear transformation.

107. (New) The method of claim 102 further including weighting each of said portions of said first electrical signal with a coefficient.

108. (New) The method of claim 102 further including filtering said output signal of at least one of said first and second compensation color channels using a low pass filter.

109. (New) The method of claim 108 further including providing said low pass filter as a Gauss low pass filter.

110. (New) The method of claim 102 further including storing said output signals of said first and second compensation color channels produced by at least one reference image as reference variables in said data mode during operation in a learning mode and further including confirming said output signals of said first and second compensation color channels generated by said identifying characteristic to be checked with said reference variables stored in said data memory during a working mode.

111. (New) The method of claim 102 further including accomplishing a comparison of said output signals of said first and second compensation color channels from said identifying characteristic to be checked with said reference variables for each pixel of said image sensor.

112. (New) The method of claim 111 further including storing output signals from several reference images as reference variables and using said several reference images for defining a tolerance window for said reference variables.

113. (New) The method of claim 102 further including providing a classification system and using said system for classification of said output signals of said compensation color channels.

114. (New) The method of claim 113 further including providing said clarification system as at least one of linear clarification systems, non-linear classification systems, threshold value classification systems, Euclidian distance classification devices, Bayes

classification devices, fuzzy classification devices and artificial neuronal networks.

115. (New) The method of claim 82 further including converting said first electrical signal from said image sensor, using at least one calculation prescription, to a translation-invariable signal with at least one characteristic value, weighing said at least one characteristic value with at least one fuzzy association function; generating a higher order fuzzy association function by linking all association functions by using a calculation prescription consisting of at least one rule; determining a sympathetic value from said higher order fuzzy association function; comparing said sympathetic value with a threshold value and making a decision regarding an association of said indentifying characteristic as a function of a result of said comparison.

116. (New) The method of claim 115 further including providing a grid of several image windows, with each of said image windows consisting of several pixels and placing said grid over said color image.

117. (New) The method of claim 116 further including dividing said color image into $M \times N$ of said image windows each having $m \times n$ pixels and providing M , N , m and n each greater than 1.

118. (New) The method of claim 115 further including providing said association characteristic having a functional connection with a value range of said characteristics value.

119. (New) The method of claim 118 further including providing said association function with at least one determined parameter.

120. (New) The method of claim 115 further including providing said calculation prescription for converting said first electrical signal from said image sensor into said translation-invariable characteristic value using a two-dimensional mathematical spectral transformation method.

121. (New) The method of claim 120 further including providing said two-dimensional mathematical spectral transformation as one of a two-dimensional Fourier, Walsh, Hadamard and circular transformation.

122. (New) The method of claim 120 further including providing said characteristics value as represented by an amount of a spectral coefficient.

123. (New) The method of claim 116 further including determining said two-dimensional spectra from said first electrical signal made available from said image sensor for each pixel for each image window.

124. (New) The method of claim 123 further including providing spectral amplitude values determined from said two-dimensional spectra and linking said spectral amplitude values to form a single sympathetic value for each said image window.

125. (New) The method of claim 115 further including providing said association functions as unimodal functions.

126. (New) The method of claim 115 further including providing said higher order association function as a multi-modal function.

127. (New) The method of claim 115 further including providing at least one of said association functions and said higher order function as a potential function.

128. (New) The method of claim 115 further including conforming at least one parameter or delivering at least one threshold value in said learning mode and evaluating said first electrical signal made available by said image sensor, in said working mode, on the basis of said results from said learning mode.

129. (New) The method of claim 115 further including providing said calculation function, by which said association functions are compared with each other, as a conjunctive association function within the meaning of IF...THEN linkage.

130. (New) The method of claim 115 further including generating said higher order fuzzy association function by processing the partial steps of premise evaluation, activation and aggregation, delivering a sympathetic value, during the course of said premise evaluation, for each IF portion of a calculation prescription, determining an association function for each IF...THEN calculation prescription and during aggregation,

said higher order association function is generated by overlapping all of said association functions during said activation.

131. (New) The method of claim 115 further including determining said sympathetic value in accordance with one of a focus and a maximum method.

132. (New) The method of claim 82 further including checking of said identifying characteristics by storing at least one background reference variable and at least one mask reference variable in said data memory, said background reference variable representing at least one property of the material to be evaluated in at least one portion of an expected range surrounding said identifying characteristic, and said mask reference variable representing one of a geometric contour of said identifying characteristic and the relative arrangement of several identifying characteristics; forming a differential value from said electrical signal made by said image sensor and said background reference variable, deriving an actual position of said identifying characteristic by comparing said differential value with said mask reference variable and blanking out an area of the material to be evaluated resulting from said actual portion of said identifying characteristic.

133. (New) The method of claim 132 further including using said background reference variable as representing a gray value of an expected range surrounding said identifying characteristic.

134. (New) The method of claim 132 further including storing a binary formation threshold in said data memory and filtering out of said differential value all first electrical signals made available by said image sensor whose values fall below said binary formation threshold.

135. (New) The method of claim 132 further including conforming said mask reference variable until a maximum agreement between said mask reference variable and said differential value results.

136. (New) The method of claim 132 further including conforming a foci of said mask reference variables with a foci of said differential value in the course of said determination of the portion of said identifying characteristic.

137. (New) The method of claim 136 further including assuming said position values are an actual position of said identifying characteristic upon a minimal deviation resulting during said comparison of said foci of said mask reference variable with said foci of said differential value.

138. (New) The method of claim 132 further including selecting said identifying characteristic in the form of strip-shaped sections.

139. (New) The method of claim 132 further including providing said identifying characteristic as a security characteristic of one of a bill and a stamp.

140. (New) The method of claim 132 further including providing said identifying characteristic as one of a window thread perforation, a hologram and a kinegram.

141. (New) The method of claim 132 further including selecting said material without an identifying characteristic, using said material in a learning mode, and deriving said background reference value from at least one property of said material to be evaluated in the expected range.

142. (New) The method of claim 132 further including using said material with said identifying characteristic for delivering said background reference variable in a learning mode wherein in case of said identifying characteristic appearing bright in comparison with an expected range, said background reference variable is derived as a threshold value from values of darkest image points of said identifying characteristic and wherein in case of said identifying characteristic appearing dark in comparison with said expected range, said background reference variable is derived as a threshold value from values of brightest image points of said identifying characteristic.

143. (New) The method of claim 132 further including delivering different background reference variables for different areas of said material.

144. (New) The method of claim 132 further including projecting said mask reference variable and said differential value onto at least one projection line and deriving an actual position of said identifying characteristic in a longitudinal direction of said

projection line from a comparison of the projection data of said mask reference value and said differential value.

145. (New) The method of claim 132 further including checking said identifying characteristic using mathematical operations of digitized input data.

146. (New) The method of claim 98 further including providing said first electrical signal as a signal value having coefficients representing portions of said first electrical signal made available by said image sensor in different signal channels; multiplying said coefficients by a correction matrix for obtaining a corrected signal vector; and supplying said corrected signal vector to a color monitor for representing a color image on said color monitor on the basis of said corrected signal vector for qualitatively evaluating said color image.

147. (New) The method of claim 146 further including providing said correction matrix as a quadratic matrix.

148. (New) The method of claim 146 further including determining coefficients of said correction matrix using an iterative approximation algorithm in which a reference color chart has been preset and in which different reference colors are represented in several color fields, wherein for each color field of said reference color chart a vector with reference values have been preset, wherein a color image from the reference color chart is recorded by said image sensor, wherein a color vector is determined for each

color field and where, in a first iteration step said signal vectors for all of said color fields are multiplied by said correction matrix and further wherein said coefficients of said correction matrix are changed in each subsequent iteration step for bringing said corrected signal vector iteratively close to said vectors with said preset reference variables.

149. (New) The method of claim 148 further including evaluating an approach of said corrected signal vectors to said vectors with said preset reference variables for each iteration step, determining a differential value between said corrected signal vector and said vector with said preset reference variables for each said color field of said reference color chart, adding up a sum of all of said differential values and assuming a change of said coefficients of said correction matrix in said actual iteration step for a subsequent iteration step only if a sum of all differential values in the actual iteration step has become smaller in comparison with a sum of all differential values in a previous iteration step.

150. (New) The method of claim 146 further including changing said signal vector in a further correction step for matching color balance, brightness and contrast, in addition to said correction with said correction matrix, by adding the product of a multiplication by said coefficients of each signal vector by signal channel-dependent correction factors, as a correction vector, to each signal vector.

151. (New) The method of claim 150 further including determining said coefficients of

said correction vector and said signal channel-dependent correction factors by presetting a reference color chart, in which different reference colors are represented in several color fields, wherein a vector with reference variables has been preset for each color field of said reference color chart, wherein a color image from said reference color chart is recorded by said image sensor, wherein a signal vector is determined for each color field, wherein said correction vector and said correction factors are selected in such a way that corrected signal vectors for two color fields having reference gray values black and white, which are obtained by appropriate addition with the correction vectors and by use of a multiplication with said signal channel-dependent correction factors again with said preset variables for these two color fields.

152. (New) The method of claim 150 further including performing said correction step for matching said color balance brightness and contrast prior to said multiplication with said correction matrix.

153. (New) The method of claim 146 further including providing said image sensor having a plurality of pixels arranged flat, with each said pixel providing at least one of said signal vectors.

154. (New) The method of claim 153 further including changing said signal vector in a further correction step, in addition to said correction with said correction matrix, for conforming the intensity values, whereby said coefficients of said corrected or uncorrected signal vectors, determined for each pixel, are each multiplied with signal

channel-dependent correction factors which have been specifically preset for each said pixel.

155. (New) The method of claim 154 further including determining said pixel-specific signal channel-dependent correction factors by lining an observation area of said image sensor with a white homogenous colored material, recording a color image using said image sensor, determining a signal vector for each pixel, defining a particular signal vector representing a brightest location in said observation area, and wherein said pixel-specific signal channel-dependent correction factors are determined for each said pixel whereby a result of a multiplication of said correction factors with said coefficients of said respective corresponding signal vectors agrees with said coefficients of said signal vectors at said brightest location in said observation area.

156. (New) The method of claim 155 further including illuminating said observation area during said determination of said pixel-specific signal channel-dependent correction factors corresponding to the illumination of said image sensor during said qualitative evaluation of said material.

157. (New) The method of claim 154 further including performing said correction step for matching said intensity levels after said multiplication with said correction matrix.

158. (New) The method of claim 157 further including raising each of said coefficients used as the basis for said corrected signal vectors to a higher power by a factor before

being transmitted to said color monitor.

159. (New) The method of claim 158 further including selecting said factor having a value between 0.3 and 0.5.

160. (New) The method of claim 158 further including selecting said factor as 0.45.

161. (New) The method of claim 146 further including changing said signal vectors in a further correction step, in addition to said correction by said correction matrix, for matching illumination conditions, with said coefficients of said corrected signal vectors correspond to a result which is obtained when said observation area is illuminated with normal light.

162. (New) The method of claim 146 further including providing said reference color chart as an IT8 chart with 288 color fields.

163. (New) The method of claim 146 further including specifying said vectors with said reference variables for said signal channels by converting CIELAB color values, which are known for the color fields of the reference chart, into appropriate coefficients for said signal channels.